Water

P.E.I.'s MOST PRECIOUS RESOURCE

GROUNDWATER RESOURCES EVALUATION

ST. LOUIS AND ST. EDWARD

THE CANADA – PRINCE EDWARD ISLAND
WATER MANAGEMENT AGREEMENT

Environment Canada Environnement Canada

Prince Edward Island
Department of the Environment

GROUNDWATER RESOURCES EVALUATION

ST. LOUIS AND ST. EDWARD

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Groundwater Resources Evaluation - St. Louis and St. Edward

Executive Summary

A review of the available hydrogeological data for the St. Louis and St. Edward area was conducted document the current status of groundwater resources in the two communities. The results of this investigation indicate that the current demands for water are adequately met by existing on-site servicing, and that groundwater quality is generally good.

Bacterial contamination of water supplies is likely to be the most common water quality concern due to relatively poor drainage in some areas and the reliance on on-site sewage disposal systems. Localized occurrences of elevated iron and manganese concentrations are a naturally occurring phenomena and do not pose a threat to human health.

Public awareness of the potential threats to groundwater can play an important role in the preservation of this resource particularly in the areas of handling, storage and disposal of hazardous materials including petroleum products and agricultural wastes, and in proper well construction and sewage disposal practices.

Because of a relatively low demand for water, and the generally low density of development in the communities, the provision of water via a central water supply system is probably not warranted a this time. Nonetheless the day may come that on-site water supplies no longer meet the needs of some portion of these communities either as a result of contamination of existing supplies or other considerations. The identification and protection of areas suitable for the development of a small central water supplies, strategically located in areas of expected greatest demand would be a worthwhile investment in order to keep future water supply options open. In identifying such sites, the ability to implement some form of well field or well head protection measures should play an important role in site selection.

Acknowledgments

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GROUNDWATER RESOURCE EVALUATION - ST. LOUIS and ST. EDWARD

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1. Introduction

This report documents the findings of a study of the groundwater resources of the Communities of St. Louis and St. Edward, conducted as part of the Groundwater Resources Evaluation Project, under the Canada - P.E.I. Water Management Agreement. The purpose of this project is to investigate, through a series of studies, the available groundwater resources on selected communities across the Island and to make recommendations regarding the most appropriate manner of developing and protecting this resource, in light of the physical constraints and expected water needs of each community.

2. Geography

2.1 Physical Geography

The communities of St. Louis and St. Edward are located near the western end of Prince Edward Island approximately 140 km from Charlottetown. The two communities extend as a corridor development over a distance of nearly 5 km along Route 152. The topography is fairly flat to gently rolling, with a few steeper hills in the vicinity of St. Louis. Maximum elevations in the area are approximately 54 m above sea level, and occur on two rises, one at the eastern end of St. Louis and the other just to the north west on the Palmer Road. The average topographic gradient is roughly north-east to south-west towards the Northumberland Strait at about 1 % or less. Locally slopes are as steep as 4%.

There are few surface water courses in the area, the predominant surface water flow being along a brook which runs in a southerly direction, crossing Route 152 just east of the Palmer Road where it joins a number of other small creeks in a swampy area just south of the Community of St. Louis. Another small creek just south of Route 152 runs approximately parallel with the road near St. Edward.

2.2 Cultural Geography

There are few statistics for the population of the two communities, and only St.Louis is incorporated. The 1986 Census indicates that St. Louis had a population of 135. It is estimated that the population of St. Edward is slightly smaller for a total population of approximately 250. Because of the physical similarity of the two communities, and there close proximity, the two are being considered as one entity for the purposes of this study. The area is primarily agricultural, with a few service industries such a grocery store, Post office, and a school and service station as well.

3. Geology

3.1 Surficial Geology

Overburden in the St. Louis / St. Edward area consists of clay and clay - silt phase ground moraine (till) west of the railway tracks, except for an area in St. Edward south of the highway, which is underlain by a clay - sand phase till. The area east of the tracks is also underlain by a clay - sand phase till (Prest, 1973). Overburden thickness, based on well drillers reports, averages about 3 m. Locally some sand rich layers have been reported at depths of 1.5 to 3 m, below ground level, but the lateral extent of these sand "lenses" is unknown.

The Soil Survey report (MacDougall & Veer, 1981) indicates soils in this area fall into three main groups. East of the railway tracks, the soils are 60% Charlottetown series, and 30% Alberry series. The Charlottetown series are moderately coarse textured, well drained to moderately well drained soils with moderate to slow subsoil permeability (less than 1 x 10-4 cm/sec) and deep water tables. The Alberry series are coarse to moderately coarse textured soils with good surface drainage and rapid to moderate sub surface permeability and deep water tables.

The remaining areas, except along the creek running parallel to the Palmer Road, are underlain by more poorly drained soils of the Margate and Duvar series. The area along the creek is underlain by O'Leary series soils, with moderate surface drainage and slow sub surface drainage. All of these latter soils typically have seasonally high water tables.

3.2 Bedrock Geology

Bedrock in the area consists of Upper Pennsylvanian to Lower Permian sedimentary strata of mega cyclic sequence IA (Van de Poll, 1981), which consist of red, coarse to fine grained sandstone and siltstone. These strata are believed to be slightly younger equivalents to the Pictou Group sediments found throughout the Maritime provinces. The environment of deposition of these sediments is believed to be fluvial in origin, and the straigraphy is characterized by rapid lateral facies changes, representing recurring fluvial cycles.

Well drillers reports indicate most wells penetrate sequences predominantly of interbedded claystone and sandstone, although a significant portion of the well logs indicate a high proportion of claystone. There are also some well logs which indicate a fairly high proportion of sandstone, but little systematic variation in rock types is apparent throughout the area. This is typical of the type of bedrock found throughout P.E.I., with individual rock units generally being of limited lateral extent.

4. Hydrogeology

4.1 Existing Well Data

The P.E.I. Dept. of the Environment has a total of 75 well drillers records for wells drilled in the St. Louis / St. Edward area since 1970. Generally the wells are relatively shallow with an average depth of 24 m. The shallowest wells are 15 m deep, and almost 30% of the wells are 18 m or less in depth. Maximum well depth in the communities is 50.3 m. Casing lengths in the communities average 11.6 m with a minimum of 27 m and a maximum of 26 m.

Static water level data from the well drillers reports indicate an average water level in the wells of 8.5 m below ground level ranging from a maximum of 21 m to a minimum of 2.5 met, however the static water level data should be viewed with a degree of caution. Because the wells on record have been drilled at different times of the year and over a considerable number of years, a certain amount of temporal variation is probably reflected in these data. In addition, some of the water level measurements may have been made before wells have completely recovered from bailing or yield testing, thus overestimating the depth of the static water level. On average it is likely that static water levels range from about 3 to 10 m below ground level. This corresponds to levels in the vicinity of 43 m above sea level in the north eastern parts of the study area, declining to around 18 m near the western end of the area.

Well yields in the study area average around 0.53 litres per second (L/sec.), with a range of 0.3 to 2.3 L/sec. While this range is relatively small compared to many other communities across the Island, it should be noted that there are no particularly heavy water users in either community, and most wells serve as domestic supplies only.

To make the well yield data more meaningful, the well depth, or more precisely, the saturated aquifer thickness penetrated by a well should be considered. All other factors being equal, a deeper well, with a greater length of open hole below the water table, would be expected to yield a greater quantity of water than a shallow well. To evaluate the water yielding characteristics of various wells them, it is useful to take into account the saturated thickness (water bearing portion) of each well when considering well yield.

As a measure of well yield then, the yield per metre of saturated thickness for each well has been calculated in litres per second per metre (L/sec/m). Figure 1 shows the distribution of values for wells in the St. Louis and St. Edwards area. The data show an average yield per saturated metre of aquifer thickness of 0.052 L/sec./m with a maximum value of 0.139 L/sec./m and a minimum of 0.012 L/sec./m. This would suggest that for an average well drilled to a depth of 30 m, with a static water level of 10 m, a yield of 1 L/sec. would be expected. While on average well yields reported from the area are somewhat lower than some

Figure 1

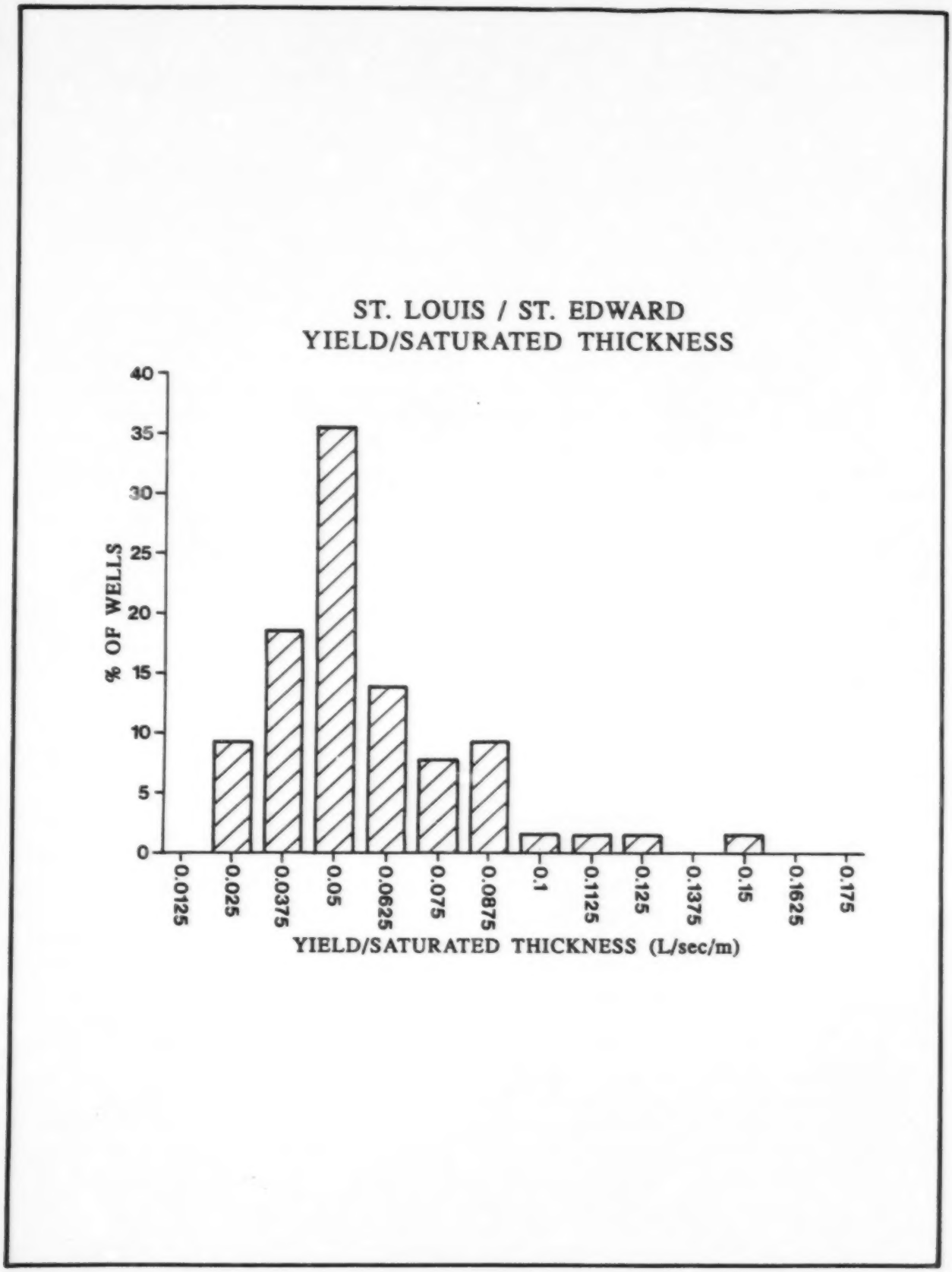
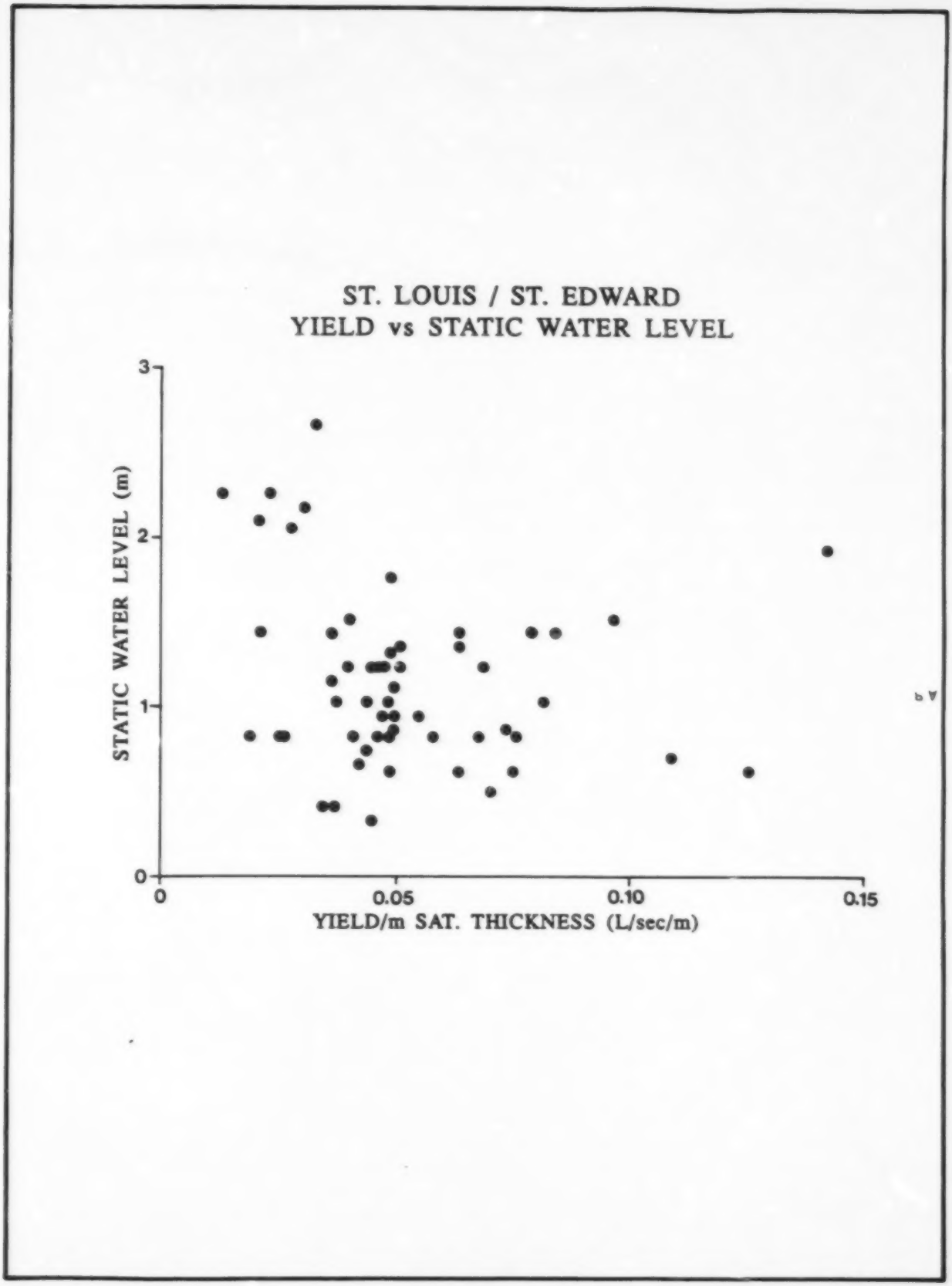

ST. LOUIS / ST. EDWARD
YIELD/SATURATED THICKNESS
% OF WELLS
40
35
30
25
20
15
10
5
0
0.0125
0.025
0.0375
0.05
0.0625
0.075
0.0875
0.1
0.1125
0.125
0.1375
0.15
0.1625
0.175
YIELD/SATURATED THICKNESS (L/sec/m)

Figure 2


ST. LOUIS / ST. EDWARD
YIELD vs STATIC WATER LEVEL
STATIC WATER LEVEL (m)
3
2
1
0
0
0.05
0.10
0.15
YIELD/m SAT. THICKNESS (L/sec/m)

other areas on the Island, it must be kept in mind that the data is almost entirely form domestic water supplies with modest water requirements they do indicate that sufficient water to meet expected demands in the future should be met without difficulty from relatively shallow wells.

Because of the relatively narrow range of well yields in the communities, it is difficult to make any correlations between well yield and other features such as well depth, static water levels or ground elevation. Frequently on the Island there is a reasonable correlation between static water level and yield per saturated thickness, with wells in areas of higher water table conditions generally showing higher yields.

This is generally attributed to the fact that fracture flow is the more significant than intergranular flow in most Island aquifers, and is the primary determinant of hydraulic conductivity (Francis, 1981). Since the frequency and size of fractures is generally greater at shallow depths these are frequently the most productive portions of the aquifer. Thus in areas of high static water levels a greater portion of this more highly fracture zone is saturated, contributing to higher well yields. Figure 2 presents a plot of the yield per meter of saturated thickness vs. static water level for wells in St. Louis and St. Edward. Although there is considerable scatter among the data a weak correlation between static water level and well yield is apparent.

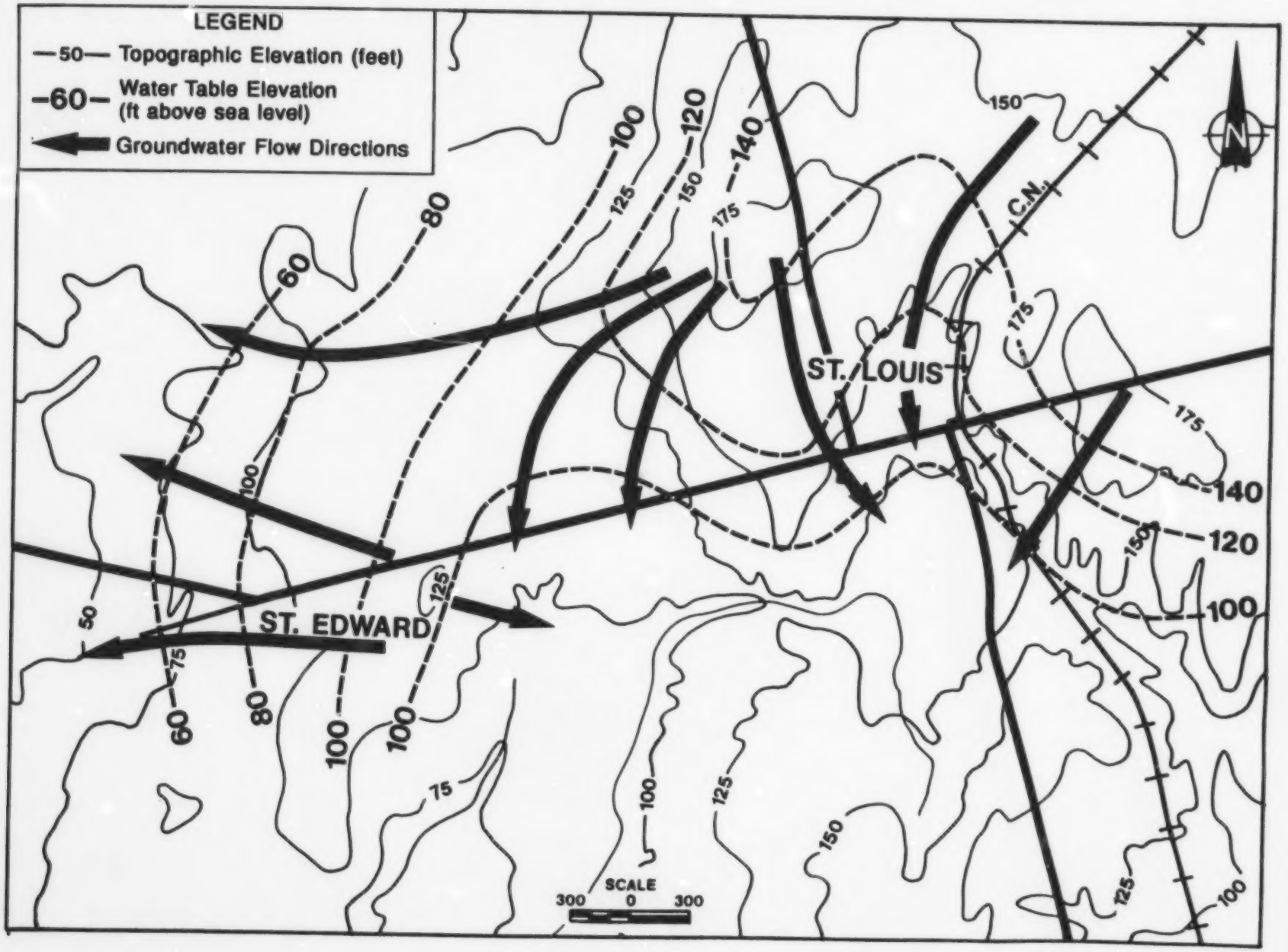
4.2 Groundwater Flow Regime

A number of factors make it difficult to draw a comprehensive picture of the groundwater flow regime in the study area. The area in question is primarily developed along Route 152, and thus most of the available data falls along a single dimension. In addition, it can be expected that a certain amount of error is incorporated in the static water level data, as these measurements have been made at different times of the year, and over a number of years, thus including temporal variations in water table elevations. Finally the data come from relatively shallow wells, and thus do not reflect conditions to any great depth. Nonetheless, the available data combined with the expected influence of local topography can show at least an approximate picture of the groundwater flow regime and flow directions in the study area.

Figure 3 presents a rather schematic representation of the groundwater flow regime in the St. Louis / St. Edward area. It should be noted that the data from which this picture was drawn is in the English system of units and no attempt has been made to convert this information to the metric system, thus water table elevations on the Figure are in <u>feet</u> above sea level not metres above sea level.

Overall, it appears that the general trend of groundwater flow is approximately southwesterly to westerly, with local changes in direction, particularly in the Palmer Road area where flow is dominantly southerly towards an area of swampy land south of the community. Another small pertubation in the groundwater flow regime may occur in the form of a groundwater divide at

Figure 3


LEGEND
—50— Topographic Elevation (feet)
–60– Water Table Elevation (ft above sea level)
Groundwater Flow Directions
ST. LOUIS
ST. EDWARD
C.N.
N
SCALE
300 0 300

a small rise just east of St. Edward. It is expected that this latter phenomena is relatively restricted in areal extent and depth. At greater depths, it is expected that the dominant groundwater flow directions will be westerly towards Northumberland Strait, following the overall topographic gradient.

The hydraulic gradient appears to be quite gentle throughout the study area in general, probably averaging around 1%. Locally, in areas of greater relief the hydraulic gradient may be somewhat steeper and may be as high as 5 % in the area to the southwest of the railway tracks south of Route 152. Throughout most of the study area recharge conditions appear to prevail, with downward vertical gradients indicated by deeper static water levels in deeper wells relative to shallow wells. In the south western part of the study area, discharge conditions may occur at shallow levels, although uncertainty over some of the static water level data make it difficult to draw any firm conclusions in this regard.

5. Groundwater Quality

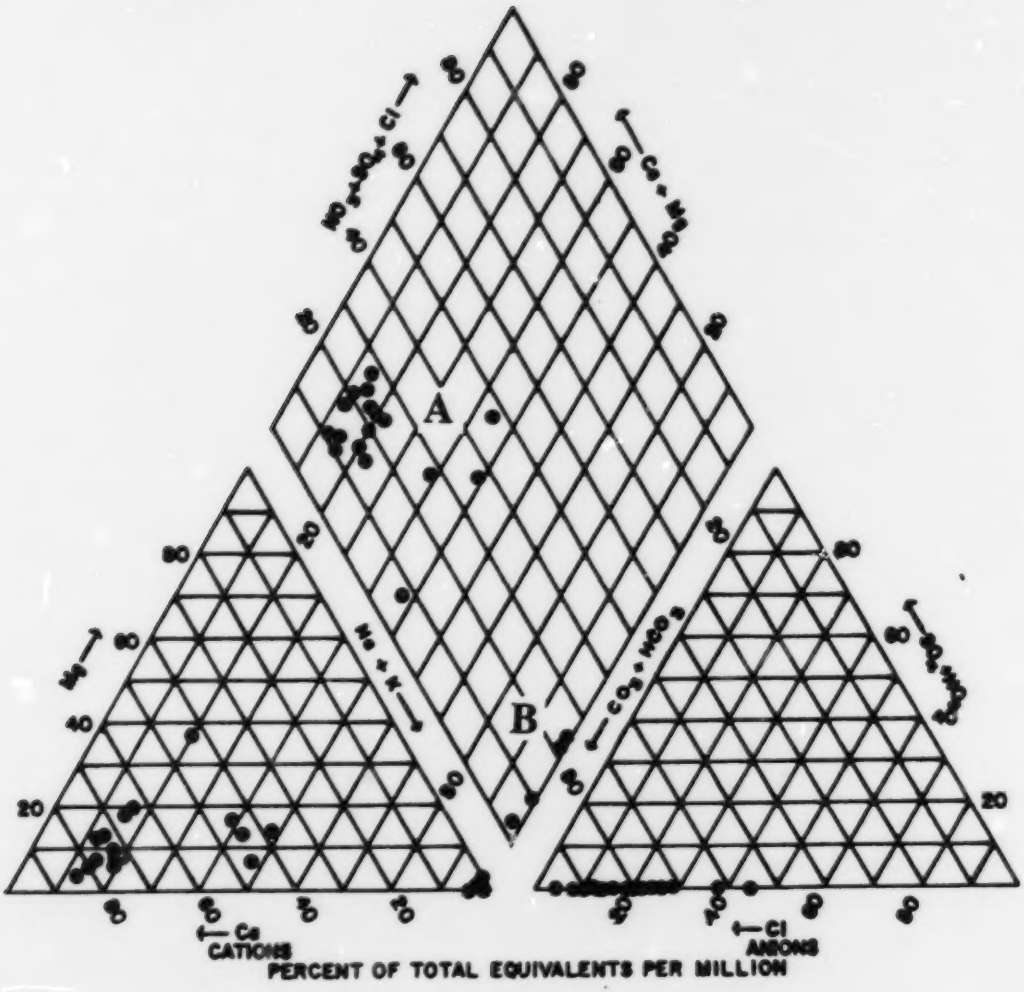
5.1 Baseline water Quality

There is only limited water quality data for the communities of St. Louis and St. Edward. The P.E.I. Department of the Environment has only 22 chemical analyses of groundwater from the area. The data do show the influences of two distinct water types however, which can be crudely correlated with depth. Throughout most of the area, water is of a calcium bicarbonate type , which is generally hard to moderately hard (generally in the range of 100 to 250 mg/L hardness). There are a couple of instances however, of a sodium bicarbonate water type, which is typically very soft. Plots of both water types are shown on the Piper diagram presented in Figure 4. Little suplphate data is available, however sulphate concentrations are generally low relative to other major ions in most P.E.I. groundwaters, and the absence of this data does not seriously effect the relative proportions of other major ions.

This latter water type is more rare, but not unknown in the area. It is believed that water of this type results from a natural softening process where by it evolves by the exchange of calcium ions in the water for sodium ions in the clay minerals of the aquifer materials . Typically, waters of this type appear to occur at greater depths than the harder, calcium bicarbonate type, and probably represent waters from deeper, more regional flow systems, with longer flow paths and greater contact time with aquifer materials.

Not far to the west, investigations in Miminegash indicate soft water with similar characteristics occurs at depth, while shallower flow systems yielded harder water of the calcium bicarbonate type. It is speculated that at Miminegash, the softer water represents the discharge end of a regional flow system and shallower water could reflect more localized systems. If this is in fact the case, the occurrence of predominantly hard water in the St. Louis / St. Edward area suggests that the area represents the upper reaches of the same regional flow system. The shorter contact time of the groundwater with the aquifer materials may account for the more

Figure 4



Major Ion Composition of Groundwaters from the St. Louis and St. Edward Area

A Ca - HCO_3 Type Water

B Na - HCO_3 Type Water

frequent occurrence of the harder calcium bicarbonate waters, with the naturally softened sodium bicarbonate waters occurring primarily at greater depths of the aquifer than are normally tapped by wells in the area.

The only other feature of note apparent in chemical analyses of groundwater from the study area are concentrations of iron and manganese. While most analyses indicate levels within the Guidelines for Canadian Drinking Water Quality (Health and Welfare Canada, 1989) there are a number of instances where these levels are exceeded, particularly for Manganese. The occurrence of elevated iron and manganese concentrations is a naturally occurring phenomena and neither the iron or manganese pose any threat to health at these levels, and the guideline values represent aesthetic concerns related to taste and staining considerations.

In the case of iron concentrations, it is primarily total iron and not dissolved iron concentrations which are elevated. This could suggest that much of the iron in the water may be carried in suspended sediment, which might be expected to be relatively high in wells developed in rock sequences dominated by claystone.

5.2 History of Water Quality Problems

There have been relatively few recorded instances of groundwater contamination in the St. Louis / St. Edward area. The most frequent problem has been the occurrence of petroleum contamination, with spills being recorded at the school , Post Office, and the service station in St. Louis. To date only the well at the service station has been affected. In each case, the presumed hydraulic gradient has been away from the spill area, with little or no development being "down gradient" from the area.

Bacterial contamination of groundwater has occurred in the past but appears to be no more common in the study area than elsewhere on the Island. Generally contamination events have occurred primarily in the spring when water tables are typically their highest. In most cases the source of the problem appears to have been flooding of tile fields from septic tanks and occurs more frequently in more poorly drained areas. It is likely that the relatively low density of housing in the area has helped to limit the extent of these problems, and it is expected that in most cases groundwater contamination has been limited to the same household from which the sewage originated.

Nitrate concentrations in the communities are generally quite low, with all but one value being below 5 mg/L (the guideline value set by Health and Welfare Canada is 10 mg/L). A single analysis indicating a concentration of 11 mg/L has been recorded. The source of nitrate at these low levels is difficult to determine, and could be a result of septic tank problems, fertilizer storage or application or other agricultural activities. A subsequent sample at this location indicated a substantial decrease in nitrate levels to 3.3 mg/L.

5.3 Potential Threats to Groundwater Quality

While there have been relatively few recorded incidents of groundwater contamination in the study area, the potential for contaminations remains. Concerns for water quality can be divided into two classes; site specific features which have the potential to contaminate the groundwater, and more general practices which can lead to problems.

Among the first category, there are several features of note. The underground petroleum storage tanks at the school, post office and service station have all leaked in the past and the recurrence of such events can not be ruled out.

There is also potential for concern regarding the dump site on the east side of the Palmer Road. The dump, is a Priority II dump site containing household, farming, metals and machinery, chemical and petroleum wastes. The dump site is located a considerable up slope from the centre portion of the community of St. Louis. The limited chemical analyses from wells in the area do not show any apparent influence from the dump site on water chemistry. Nonetheless, the potential for contamination from the site exists, particularly if wastes which are relatively mobile (soluble) and persistent are disposed at the site.

Another potential source for contamination is the practice of dumping or burying cull potatoes at the potato warehouse just east of the railway tracks, north of Route 152. While this is primarily an aesthetic concern, breakdown products from excessive quantities of vegetable matter might have the potential to leach undesirable concentrations of mineral species from the soil and bedrock, releasing them to the groundwater. In addition, the high concentration of organic material has the potential to locally reduce permeability and can have deleterious effect on well performance and pumping equipment, as well as having the potential to encourage excessive amounts of bacteria in the water.

It is likely that the practice of dumping potatoes could also have an adverse effect on surface water courses in the area, particularly in terms of increased organic loadings and increased biological oxygen demand (BOD).

In addition to these specific sites where the potential for contamination exist, there are a few general issues which have the potential to impact on groundwater quality. In these instances public awareness of some of the more common threats to water quality is probably the best preventative measure that can be taken to ensure water quality.

One of the most obvious sources for contamination in the area are malfunctioning or poorly sited septic systems. Certain parts of the communities are situated on relatively poorly drained land, and particularly in the spring of the year when water table elevations are likely to be highest, tile fields may be flooded, resulting in ineffective treatment of sewage. While the ef-

fects of such contamination are likely to be of limited extent, the potential health risks from bacterial contamination could be expected to be at least as serious as from other sources of contamination.

While poorly operating septic systems are a likely source of contamination, other sources of bacteria such as surface run-off can contaminate groundwater. For this reason care should also be taken to ensure proper well construction, which will substantially reduce the probability of contamination.

Finally it is worth mentioning also that while large underground petroleum storage tanks perhaps pose a greater risk to groundwater resources when taken individually, because of their numbers, domestic home heating oil tanks have statistically account for a significant portion of contamination events.

6. Planning Considerations

6.1 Availability of Groundwater

Analysis of the available data indicate that while individual well yields in the St. Louis / St. Edward area are relatively modest when compared to some other parts of the Island, a more than adequate supply of water for the expected development in the area can be provided from individual on-site water supplies in the foreseeable future. In addition it should be pointed out that the relatively modest well yields are probably as much a reflection of demand for water as aquifer characteristics, and in the absence of any evidence to the contrary, there is no reason to believe that higher flows could be developed.

In the event that larger demands for groundwater do arise in the communities, it is likely that substantial quantities of water could be developed through proper assessment of site specific conditions.

Natural water quality in the study area is generally good with the exception of the occasional occurrence of slightly elevated iron and manganese concentration. Incidences of groundwater contamination in the area have been relatively few, and should not be expected to increase substantially unless a considerable degree of additional development in the area occurs.

Because of the ready availability of sufficient quantities and quality of groundwater, as well as the distribution and relatively low density of development in the area, the continued use of on-site water supplies is probably most appropriate for the communities in the foreseeable future.

Besides being prohibitively expensive to service an area as spread out as St. Louis and St. Edward with central water, such a system would not be expected to show much in the way of tangible benefits to the residences. As a central system would be supplied by water from the same aquifer as the current on-site water supplies, no substantial improvement in water quality could be expected unless treatment facilities were also provided.

It is most likely that if some form of central water supply is ever adopted in the communities, it will be in response to contamination of existing water supplies, and would likely be sized to accommodate only the areas affected. Under such circumstances, it is likely that a sufficient quantity of water could be developed virtually anywhere in the community with the construction of 1 or 2 wells, considering that a supply of about 3 L/sec. would be adequate to meet the peak flow requirements of the both communities at present.

6.2 Groundwater Protection Strategies

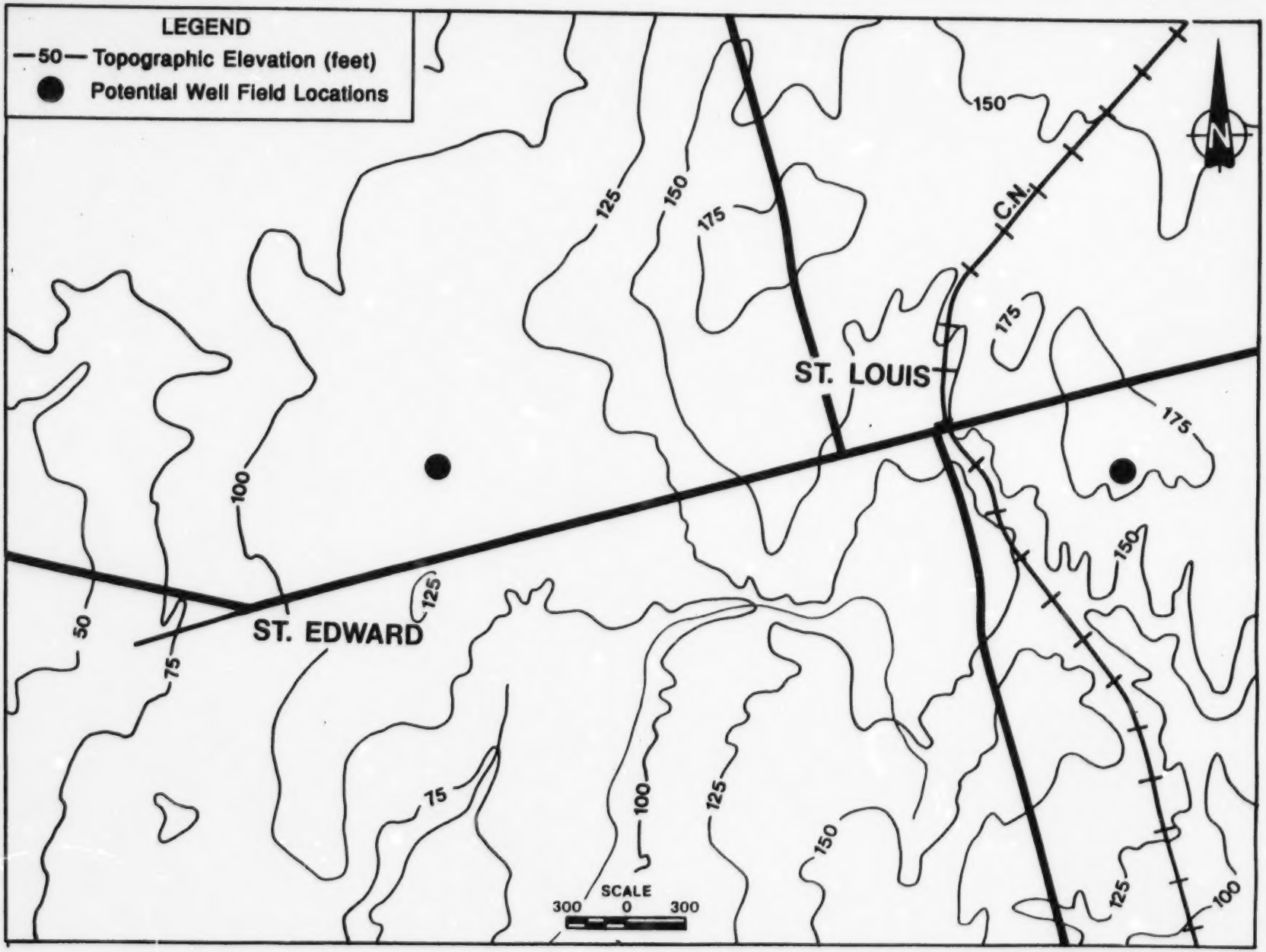
In the previous section it was indicated that it is rather unlikely that the provision of central water to the communities of St. Louis and St. Edward would provide any tangible benefits to the residents at this time. From this point of view, efforts would be more profitably directed at protecting the existing sources of supply (on-site water supplies) and the groundwater resource in general. At the same time, it would be prudent for the two communities to identify areas which could be developed for central water supply should the need arise in the future, and implement steps which would ensure the continued quality of this resource.

Towards the first approach (ie ensuring the quality of water from existing supplies) there are a number of factors which should be considered. Particular attention to the construction and maintenance of septic systems in areas where drainage characteristics are less than ideal will help reduce the probability of bacterial contamination of water supplies. Similarly, ensuring that wells are properly constructed, with adequate casing lengths, casing properly grouted in the ground, and completed either with pitless adapters or water tight well pits will also reduce the probability of contamination from surface or near surface waters.

In an area where sewage treatment/ disposal is achieved through on-site systems, and especially in areas where soil conditions are less than ideal, lot sizes should be sufficiently large to ensure adequate spacing between tile fields and wells, and preferably leaving sufficient room to utilize an alternate location for the tile field (or well) at some future date.

Abandoned wells should be properly filled so as not to leave open conduits between sources of undesirable water or the surface and deeper levels of the aquifer tapped by other wells. This is particularly important in the case of wells which have been abandoned because of poor water quality in the first place.

Figure 5


LEGEND
—50— Topographic Elevation (feet)
Potential Well Field Locations
ST. LOUIS
ST. EDWARD
C.N.
N
SCALE
300 0 300
50
75
100
125
150
175

Naturally care should be taken to avoid the introduction of potential contaminants into the groundwater system in any area. Particular care should be exercised in the handling and storage of hazardous chemicals including pesticides, petroleum products and other wastes.

As a safeguard for the future, it is also prudent to identify areas within the communities which could be developed for water supply purposes at some time in the future if the need arose.

At the present time it appears that any move towards centralized water supply would be in response to contamination of existing sources of supply. Because it is highly unlikely that an event of this nature would have an effect on a large part of the study area, and because the costs which would be involved in providing central water to the entire area would be so high, it is more likely that relatively small "cluster" systems would probably best meet the needs of an effected area. In this case an area in which existing on - site water supplies were rendered unusable could be serviced by a small central water supply system, probably supplied by a single well.

While it is impossible to predict with a great deal of certainty where such a need for such a water supply system might develop, it is probably reasonable to presume that contamination of groundwater is most likely in the areas with the greatest density of development. From this perspective, it is suggested as a first step that land suitable for the development of a small central water supply be identified near the centre of each community. Once identified, steps should be taken to ensure the continued quality of water in the area. Suitable measures most likely would involve restriction or prohibition of some land use practices such as storage or handling of hazardous materials, construction of rock pits, storage of road salt or residential development. In addition some restrictions may be warranted for areas immediately uphill from such a site such as in the case of more mobile or persistent hazardous materials.

Because the expected demand for water is not likely to be great, the area of land required in each location might be relatively small, perhaps an area with a radius of 100 m. Two areas for consideration are outlined on Figure 5 .

7. Conclusions and Recommendations

At the present time, the groundwater resources in the communities of St. Louis and St. Edward are of basically good quality, and of adequate quantity. Naturally occurring high iron and manganese concentrations are the principle exception to this, but pose no health threat and few limitations to water use. There have been some instances of groundwater contamination in the past but these have fortunately only had localized effect.

Because of the relatively poorly drained soils in parts of the communities, it is expected that bacterial contamination of water supplies is the single most important concern for water quality. Particular care in the siting and construction of water supplies and septic systems are likely to be the most effective way of meeting these concerns.

The preservation of existing water quality will also depend in part on sensible land use and industrial / commercial practices involving the storage and handling of agricultural chemicals and wastes, petroleum products and municipal wastes.

Because of the relatively spread out distribution of development within the area, central water supply does not appear to be a reasonable alternative to the present on - site water supplies utilized in the area. It is more likely that if water quality constraints require development of alternative water supplies in the area, this could be achieved by the development of relatively small "cluster systems" supplying portions of the community effected by poor water quality, to the entire two communities. Towards this end it would be prudent to identify a number of strategic locations within the study area where water supplies could be developed.

Because it is expected that the quantities of water that might be required are likely to be relatively modest, water quality considerations and the ability to adequately protect groundwater resources in the area, should be prime considerations in the selections of these sites. Section 6 makes some suggestions as to areas worthy of consideration for future water supply development.

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APPENDIX I

WATER WELL DATA

APPENDIX I

ST LOUIS/ST EDWARD WATER WELL DATA

Name	Date	East. (m)	North. (m)	Depth (ft)	G.S. Elev. (ft)	S.W.L. (ft)	Casing Length (ft)	Yield (lgpm)	Time (min)	Geology	Aquifers (Water Occurrences)					
Audrey Wedge	761223	408300	5192500	88	25	20	44	8	10	0-12 Clay till	50	55	75	80		
										12-88 Sandstone and claystone						
Elmer Wedge	700718	408300	5192500	75	25	20	40	8	15	0-28 Sandstone and clay	42	45	72	75		
										28-75 Sandstone, some claystone						
Alyre Wedge	760808	408400	5192100	50	50	17	27	10	9	0-27 Till	31	34	47	50		
										27-50 Sandstone						
Arnold Wedge	801014	408400	5192700	50	50	12	32	5	5	0-31 Sand and claystone	35	38	45	48		
										31-50 Sandstone						
David Carragher	830509	408400	5192500	50	50	18	32			0-38 Sand and claystone	40	43	45	48		
										38-50 Sandstone, some claystone						
Andrew Allain	810214	408600	5192600	60	50	18	34	5	5	0-3 Clay	50	53				
										3-60 Sandstone, some claystone						
Eileen Butler	790719	408600	5192500	61	50	26	36	5	5	0-2 Clay	40	43	50	61		
										2-61 Sandstone and claystone						
Roger Tremblay	790829	408200	5192200	104	100	66	32	5	15	0-32 Claystone	32	33	58	61	100	104
										32-104 Sandstone, some claystone						
Wilbert Chaleson	780707	408204	5192192	100	50	51	42	4	5	0-22 Till	69	72	84	88		
										22-100 Claystone and siltstone						
Wilfred Chaleson	800222	408300	5192100	100	100	26	85	5	10	0-35 Claystone	96	100				
										35-100 Sandstone and claystone						
David Murray	831103	408400	5192100	150	125	85	86			0-80 Sandstone and claystone	100	103	148	150		
										80-150 Sandstone, some claystone						
Wesley Arsenault	770822	408400	5192300	103	75	53	51	6	10	0-14 Clay till	65	70	90	100		
										14-103 Claystone, some sandstone						
Eric Chaleson		408400	5192300	110	100	55	80	5	15	0-50 Claystone	80	83	105	108		
										50-110 Sandstone, some claystone						
John Chaleson	831011	408400	5192400	165	100	70	70			0-100 Layered sandstone and claystone	105	108	160	163		
										100-165 Sandstone, some claystone						
Mrs. Kevin Petrie	760910	408404	5192193	63	75		30	10	6	0-24 Sand till	54	57				
										24-63 Claystone and siltstone, some sandstone						
Danny Chaleson	810818	408600	5192100	155	100	65	56	5	15	0-155 Claystone with sandstone layers	65	68	125	128	150	153
Reggie Chaleson	810320	408500	5192400	120	100	50	74	5	10	0-3 Clay	100	103	115	118		
										3-120 Claystone, some sandstone						

Name	Date	East. (m)	North. (m)	Depth (ft)	G.S. Elev. (ft)	S.W.L. (ft)	Casing Length (ft)	Yield (igpm)	Time (min)	Geology	Aquifers (Water Occurrences)
Prebuilt Structures	770301	409600	5192200	145	100	20	65	8	10	0-18 Clay till 18-145 Claystone, sandstone layers	70 80 125 135
Wilbert Bernard	830722	409600	5192200	145	100	50	53			0-3 Clay 3-145 Claystone, sandstone layers	85 88 140 143
Larry Jones	790921	409600	5191800	50	100	37	34	5	5	0-3 Clay 3-50 Sandstone and claystone	35 38 46 49
Dale Hustler	770421	409600	5192000	70	75	8	25	8	15	0-12 Clay till 12-70 Sandstone and claystone	30 35 55 60
Wesley Arsenault	830803	409600	5192400	55	100	15	24			0-20 Sand and claystone 20-55 Sandstone, some claystone	40 43 50 53
Martin MacRae	751003	409613	5192794	60	100	21	29	9	5	0-15 Till 15-60 Siltstone and claystone	31 56
Herbert Perry	770422	409900	5192200	75	80	10	34	6	15	0-16 Clay till 16-75 Claystone, some sandstone	40 45 55 60
Gordon Bernard	830627	410100	5192200	65	100	25	40			0-3 Clay 3-65 Sandstone and claystone	40 43 63 66
James McCarthy	791004	410100	5192300	85	100		15			0-5 Clay 5-85 Claystone, sandstone layers	45 48
George Bernard	830707	410200	5192200	100	100	20	33			0-2 Clay 2-100 Claystone, some sandstone	37 40 97 100
Frank Perry	770427	410300	5192300	81	80	10	37	6	15	0-5 Clay till 5-81 Sandstone and siltstone	40 45 72 76
Edward Perry	830720	410400	5192300	70	100	15	38			0-2 Clay 2-70 Claystone, some sandstone	40 43 66 68
Wilbert Thibodeau	811005	410500	5192400	65	125	28	30	5	5	0-3 Till 3-65 Claystone, some sandstone	48 51 62 65
Wilcey Thibodeau	770105	410600	5192300	72	100	23	31	8	10	0-9 Clay till 9-72 Sandstone and claystone	40 45 60 70
Emiline Smith	721215	410703	5192443	90	100	16	42	8	15	0-8 Clay till 8-90 Sandstone and claystone	45 48 75 78
Donald Perry	760727	410799	5192492	73	100	21	32	8	10	0-14 Clay till 14-73 Sandstone and claystone	35 38 65 68
Abby Perry	761230	410800	5192700	85	115	27	44	8	10	0-7 Clay till 7-85 Sandstone and claystone	45 55 75 80

Name	Date	East. (m)	North. (m)	Depth (ft)	G.S. Elev. (ft)	S.W.L. (ft)	Casing Length (ft)	Yield (igpm)	Time (min)	Geology	Aquifers (Water Occurrences)
Perry Nelson	750414	410900	5192500	81	115		38	8	15	0-10 Sand till 10-81 Sandstone and claystone	
Lee Gaudet	790704	410800	5193900	89	100	43	33	8	7	0-7 Clay and sand 7-89 Sandstone and claystone	51 84 88 89
Ronald Arsenault	820513	411100	5192500	85	125	35	50	5	10	0-3 Clay 3-85 Sandstone and claystone	85 89 84 85
Donald Bernard	780521	411100	5193800	74	100	23	31	8	10	0-11 Clay till 11-74 Sandstone and claystone	31 35 45 80 80 70
Nelson Deagle	810810	411100	5193900	85	125	35	35	5	10	0-3 Till 3-85 Claystone, sandstone layers	35 38 80 83 82 88
Keith Conworthy	800725	411400	5193900	80	125	15	23			0-18 Claystone 18-80 Sandstone and claystone	35 38
Jerry Delaney	790101	411400	5193800	80	120	20	40	15	10	0-10 Clay till 10-80 Claystone, some sandstone	80 85 80 85
Ben Gaudet	791212	411500	5193800	80	125	20	30	5	10	0-80 Claystone, sandstone layers	80 83
Billy Shield	800517	411900	5193900	80	125	15	30	5	5	0-5 Claystone 5-80 Sandstone, some claystone	45 48
James Hinch	781207	411900	5195800	73	100	25	31	8	10	0-14 Clay till 14-73 Sandstone and claystone	35 40 80 85
Valmore Gaudet	781229	413000	5192700	88	125	20	42	8	10	0-18 Clay till 18-88 Sandstone, some claystone	45 80 75 80
Roy Hustler	781208	412000	5192800	73	125	20	43	8	10	0-14 Clay till 14-73 Sandstone and claystone	80 70
North Star Constr'n	810909	412100	5192700	85	125	20	29	5	5	0-3 Till 3-85 Sandstone, some claystone	42 45 52 55
George Gallant	780526	412300	5193800	82	175	30	23	5	10	0-10 Clay and sand till 10-82 Sandstone and claystone	85 88 80 82
Harry Gallant	780803	412300	5193800	81	175					0-20 Till 20-81 Sandstone	
Gerald Doucette	780808	412300	5194200	75	150	37	37	8	10	0-18 Sand till 18-75 Sandstone	45 80 70 74
Inman Plumbing	781105	412400	5192900	70	100		39	10	10	0-15 Mud 15-70 Sandstone	

Name	Date	East. (m)	North. (m)	Depth (ft)	G.S. Elev. (ft)	S.W.L. (ft)	Casing Length (ft)	Yield (lgpm)	Time (min)	Geology	Aquifers (Water Occurrences)					
Alfred H. Doucette	780807	412400	5195130	67	150	30	33	6	12	0-14 Sand till	46	50	60	63		
										14-67 Sandstone and claystone						
St. Louis School	720704	412501	5192695	100	100	47	48	30	180	0-15 Clay till	60	70	85	90		
										15-100 Claystone, sandstone layers						
St. Louis School		412501	5192695	150		50	61	15	30	0-4 Clay till	81	90				
										4-150 Claystone, some sandstone						
Austin Doucette	840503	412700	5193700	70	125	25	39	10	5	0-15 Sand and claystone	39	41	52	56	68	70
										15-70 Sandstone and claystone						
Gerard Blanchard	830329	412800	5192900	83	125	20	35	5	5	0-5 Clay	43	48	80	83		
										5-83 Sandstone and claystone						
Frank Shea	700715	412800	5193000	57	125	15	25	9	15	0-20 Sandstone and clay	25	36	54	57		
										20-57 Sandstone and claystone						
Roland Gaudet	790416	412800	5193100	50	150	35	28	5	5	0-3 Clay	48	51				
										3-50 Claystone and sandstone						
Donald Arsenault	760809	412801	5192393	60	75	23	22	8	6	0-20 Till	31	34	53	56		
										20-60 Claystone, some sandstone						
Billy Gallant	780822	412900	5192900	68	125	15	36	8	10	0-7 Clay till	36	40	65	66		
										7-68 Sandstone, some claystone						
North Star Constr'n	810903	412900	5192900	67	125	25	33	5	5	0-3 Till	46	48	65	67		
										3-67 Sandstone and claystone						
Everett Wedge Jr.	820216	412900	5193100	65	150	28	30	5	10	0-3 Clay	40	43	62	65		
										3-65 Sandstone and claystone						
F.J. Shea & Son	810827	413100	5192900	85	125	30	60	5	10	0-3 Till	70	73	83	85		
										3-85 Sandstone, some claystone						
Dennis McCormick	820530	413100	5103100	68	125	25	34	5	5	0-3 Clay	46	48	66	68		
										3-68 Sandstone and claystone						
Cyril Doucette	790927	413400	5193100	75	125	30	38	10	10	0-11 Clay till	40	46	60	70		
										11-75 Sandstone and claystone						
Willard Mokler	781101	413400	5193200	73	130	33	43	6	10	0-10 Till	48	50	68	71		
										10-73 Sandstone, some claystone						
Rec. Project	811204	413600	5193100	65	125	20	34	5	5	0-3 Clay	40	43	64	65		
										3-65 Sandstone and claystone						
Ronnie Gaudet	800814	413600	5193200	58	125	32	30	5	5	0-2 Clay	40	43	57	58		
										2-58 Sandstone and claystone						

Name	Date	East. (m)	North. (m)	Depth (ft)	G.S. Elev. (ft)	S.W.L. (ft)	Casing Length (ft)	Yield (lgpm)	Time (min)	Geology	Aquifers (Water Occurrences)
Emmuel Arsenault	800728	413800	5193100	68	165	33	38	5	5	0-10 Sand and claystone 10-68 Sandstone, some claystone	42 48
Patrick Mallett	860730	414100	5193300	52	125	20	38			0-2 Clay 2-52 Sandstone and claystone	42 46 50 52
Brian Shea	790831	414500	5193300	65	150	35	33	5	5	0-3 Clay 3-66 Sandstone, some claystone	46 48 53 55
Dean Hustler	851221	414700	5193600	66	160	22	30			0-3 Clay 3-66 Sandstone and claystone	30 33 41 44 55 58
Fred Arsenault	820630	414800	5193800	64	150	25	35	5	5	0-2 Clay 2-64 Sandstone and claystone	40 43 62 64
Ernst Mallett	801002	415300	5193400	60	125	18	31	5	5	0-7 Sand and claystone 7-60 Sandstone and claystone	35 38 55 58
Frances Pickard	781202	415700	5193600	70	135	35	35	5	5	0-8 Clay 8-70 Sandstone, some claystone	26 27 31 34 66 70
Lee Perry	770609	416000	5193000	66	135	15	39	10	10	0-11 Clay till 11-66 Sandstone, some claystone	46 55
Francis Shea	770622	416100	5193700	73	130	30	30	8	10	0-12 Clay till 12-73 Sandstone and claystone	35 40 60 65
			Averages	78		28	36	7			

APPENDIX II

WATER QUALITY DATA

APPENDIX II
Water Quality Analyses
ST LOUIS/ST EDWARDS

Name&Date		Easting/Northing	Parameters Ca	Mg	Na	K	Hard.	Alk.	Cl	SO4	P	NO3	pH	Fe (T)	Fe (D)	Mn	Cd	Cu	Cr	Ni	Pb	Zn
Alb. Arsenault	780818	416110/5193940	40.0	1.70	7.5	0.70	108.0	73	16		0.12	0.8	7.7	0.0	< 0.1	< 0.02		< 0.02			< 0.1	0.03
Paul Brown	861014	413005/5193000	38.9	3.37	9.9	1.70	112.5	140	16		0.06	2.6	8.2	0.3	< 0.1	< 0.02		0.06			< 0.1	0.83
Anne Doucette	870720	413200/5193300	54.6	1.99	9.4	1.90	145.8	105	18		0.18	4.6	7.6	1.2	< 0.1	0.09		0.04			< 0.1	0.82
Island Tel	800908		62.5	3.90	12.0	1.05		191	17		0.10	0.5	7.4	0.2		0.37		< 0.02			< 0.1	0.95
Leo C. Perry	780818	416000/5193650	69.0	5.30	12.5	17.00	188.0	138	25		0.06	4.9	8.8	0.0	< 0.1	< 0.02		0.12			< 0.1	0.12
St.L. Elementary	840329	412250/5192710	37.8	7.24	9.9	2.38	124.4	160	14		0.17	0.4	7.5	< 0.1	< 0.1	< 0.02		< 0.02			< 0.1	0.03
St.L. Elementary	850212	412250/5192710	44.0	7.77	9.9	2.49	143.5	157	15		0.12	0.4	8.1	< 0.1	< 0.1	< 0.02		0.02			< 0.1	0.96
Art. Arsenault	861112	411950/5192800	104.9	12.28	26.4	0.77	314.6	286	60		0.07	0.8	8.0	0.7	< 0.1	0.88		0.13			< 0.1	0.27
Wes. Arsenault	851217	409600/5192290	4.0	0.35	184.0	1.70	12.2	251	8		0.03	0.2	8.4	0.2	< 0.1	< 0.02		0.08			< 0.1	0.37
Wes. Arsenault	860211	409600/5192290	0.8	0.10	116.0	1.03	2.7	219	17		0.05	0.3	8.5	< 0.1	< 0.1	< 0.02		0.03			< 0.1	0.05
Wes. Arsenault	860408	409600/5192290	0.9	< 0.02	164.0	0.27	2.7	215	40		0.04	< 0.2	8.2	< 0.1	< 0.1	< 0.02		< 0.02			< 0.1	0.14
Gary Boston	850611	409730/5192150	66.6	6.15	25.2	1.15	247.9	251	50		0.08	2.7	7.8	< 0.1	< 0.1	< 0.02		0.08			< 0.1	0.43
Gary Boston	860311	409730/5192150	63.3	4.05	26.7	0.90	225.6	230	50		0.12	3.2	7.0	< 0.1	< 0.1	< 0.02		0.11			< 0.1	0.45
George Bernard	831208	410400/5192300	25.5	4.89	22.0	24.00	85.9	90	26		0.08	11.0	6.5	0.2	< 0.1	0.14		0.05			< 0.1	1.06
George Bernard	840110	410400/5192300	24.2	4.30	21.0	11.00	79.9	85	30		0.04	3.3	8.4	0.2	< 0.1	0.10		0.02			< 0.1	0.89
Emile Doucette	851217	409650/5192400	31.1	2.28	35.0	2.84	88.2	141	8		< 0.02	1.0	7.9	0.3	< 0.1	0.02		0.07			< 0.1	0.65
John Doucette	850611	409600/5192150	18.4	8.80	7.7	1.65	77.6	89	12		0.06	3.0	7.7	< 0.1	< 0.1	< 0.02		0.06			< 0.1	0.29
Lloyd Elsworth	850326	410650/5192600	86.9	9.31	16.2	1.16	256.6	236	60	5	0.13	1.8	8.9	0.2	< 0.1	0.06	< 0.02	0.07	< 0.05	< 0.05	< 0.1	0.88
Emile Gallant	851127	408250/5192750	58.1	4.44	14.5	0.84	166.9	196	26		0.14	3.5	7.2	1.4	< 0.1	1.46		0.05			< 0.1	0.44
David Murray	860211	408400/5192100	2.1	0.46	185.0	1.38	7.8	219	50		0.05	< 0.2	8.3	< 0.1	< 0.1	< 0.02		0.06			< 0.1	0.28
Haym. Richards	841106	410250/5192350	22.9	5.28	22.6	0.89	80.3	29	50		0.16	2.6	5.8	0.2	< 0.1	0.06		0.02			< 0.1	0.69
Elton Wedge	860204	408250/5192500	51.1	3.89	16.7	1.12	145.4	194	22		0.10	< 0.2	7.4	< 0.1	< 0.1	0.82		0.02			< 0.1	0.06
		CDWS							250	500		10.0	6.5-8.	0.3		0.05	0.005	1.00	0.05		0.05	5.00